Exploring the atmospheres of solar system planets and moons using infra-red spectroscopy

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Project Background

The solar system contains a vast variety of planetary atmospheres, from the tenuous gas envelopes surrounding the Galilean satellites, to the thick atmospheres of organic-rich Titan and the massive atmospheres the giant planets themselves. The main technique used to probe the composition and dynamics of these atmospheres is remote sensing and infra-red spectroscopy, where the emission lines of trace gas species are used to determine temperature and gas profiles. These measurements can be used to improve our understanding of how the planets evolved and how planetary atmospheres work in general.

Project Aims and Methods

The project will use a combination of spectra measured by spacecraft and ground/space-based telescopes to improve our understanding of planetary atmospheres in our solar system. Data will be from Cassini, ExoMars, the Atacama Large Millimeter/sub-millimeter Array, or the James Webb Space Telescope. For example, trace gas emission lines could be used to determine the composition and seasonal circulation changes occurring in Titan’s atmosphere. The project could also involve analysis of spectroscopic data from Mars, Uranus, or Neptune.

Spectra will be analysed using radiative transfer theory. This involves developing a forward model of the atmospheric state by assembling existing constraints on temperature and gas concentrations along with spectroscopic parameters from laboratory studies. Inverse theory techniques are then used to recover the temperature and composition that best fit the observed data and existing constraints. The physical state of the atmosphere can then be used to develop interpretations for atmospheric circulation, formation, or evolution.
Candidate

Ideally a background in physics to MSc/MSci level. A strong interest in planetary science, atmospheric physics, and numerical analysis techniques is essential. Familiarity with scientific computing/programming would be a definite advantage as the main component of the project will be quantitative analysis of spectroscopic datasets.

Training

Skills will be built up mainly via independent study and one-to-one supervision, but will also include attendance of specific lecture courses and workshops (as required). The student will be expected to present results at national and international conferences and to publish findings in international journals. This will require excellent communication and written skills. The project will require the development of skills in atmospheric and planetary science, remote sensing, radiative transfer modelling, inverse theory, and numerical analysis. This will leave the candidate in an excellent position for a career in atmospheric/planetary science, or any field requiring numerical data analysis.

References / Reading List


Links

http://www.bristol.ac.uk/earthsciences/courses/postgraduate/


ExoMars Mission: http://exploration.esa.int/mars/46475-trace-gas-orbiter/

JWST Mission: https://www.jwst.nasa.gov

ALMA Telescope: http://www.almascience.org

Application deadline: 23.59 GMT, Monday 2nd April 2018

How to apply to the University of Bristol: http://www.bristol.ac.uk/study/postgraduate/apply/.

Please select PhD in Geology as the programme in the online application system.